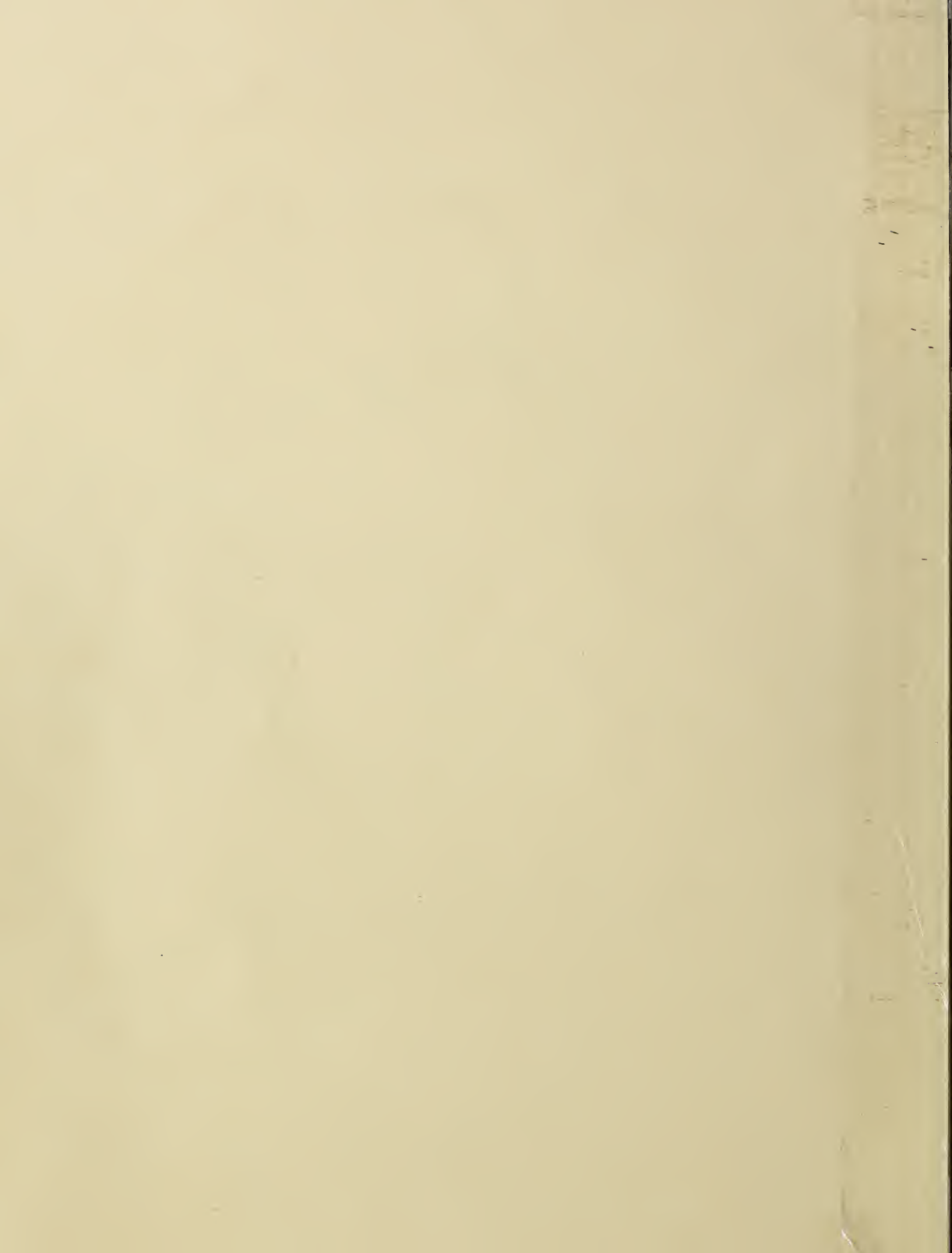


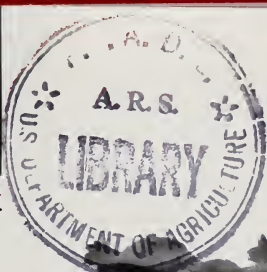
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# AGRICULTURAL Research

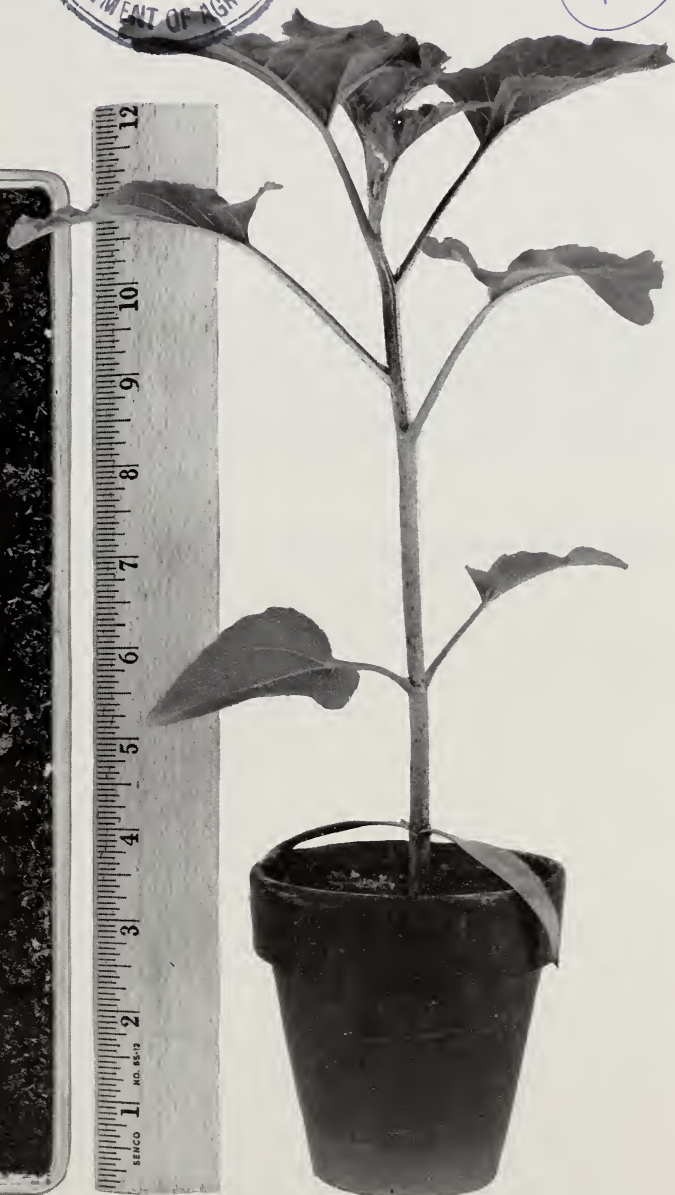
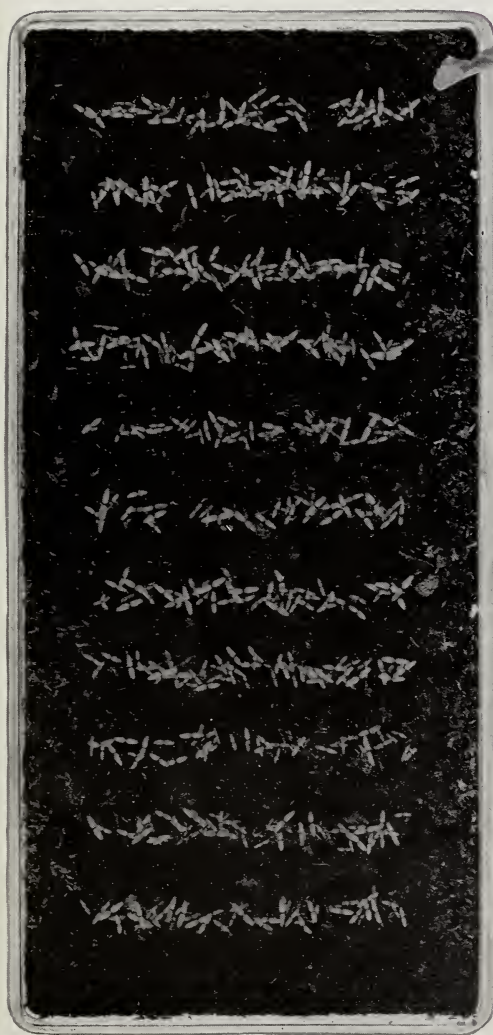
U.S. DEPARTMENT OF AGRICULTURE



JULY 1963

*F. B. Shanks*

CATALOGED  
P. 7



A Tiny Test Plant  
Page 8



# AGRICULTURAL Research

JULY 1963/VOL. 12, NO. 1

## Quest for Knowledge

General acceptance of new crop varieties by U.S. growers during the last 25 years is a phenomenon typical of agriculture's continuing revolution.

During 1962 alone, 83 new crop varieties were released by ARS in cooperation with State agricultural experiment stations, enabling growers to produce higher quality food, feed, and fiber. In the last 25 years—

- Growers of corn, soybeans, and flaxseed have made a complete change in varieties they grow;
- Growers of oats have made three major changeovers in varieties to combat new races of rust;
- Growers of wheat have made an 88-percent change-over. And, when stem rust nearly wiped out durum wheat in 1950, accelerated research produced four new resistant varieties in 5 years.

In fact, farmers are planting almost none of the commercial crop varieties they produced 25 years ago, illustrating how rapidly research has been put to use.

It is easy to maintain enthusiasm for this type of research. But many people do not realize that the 83 new varieties released in 1962 actually had their beginning in a quest for basic knowledge many years ago. Such a quest led W. A. Orton, working with cotton 60 years ago, to the discovery that disease resistance could be bred into plants; it also led to the principle of breeding hybrid vigor into farm crops.

Today, this same thirst for knowledge is motivating new designs for the crop varieties of the future.

A team of ARS and North Dakota scientists has found that the presence (or absence) of a protein identical to a protein found in a specific disease organism may account for susceptibility (or resistance) of a plant to the disease. When this discovery is applied through further research, and related to all major crops and diseases, we can develop resistant plants more quickly and at a lower cost. It could even be a clue to faster, more efficient insect control.

To insure a continuing foundation for applied research, the proportion of basic research has risen from 7 to about 35 percent—in only 12 years. This trend is expected to go on until 50 cents of every ARS research dollar goes into the quest for basic knowledge.

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Orville L. Freeman, Secretary,

U. S. Department of Agriculture

B. T. Shaw, Administrator,

AGRICULTURAL RESEARCH SERVICE

*L. L. Layton uses monkeys from the Philippine Islands as stand-ins for humans in a test he developed to detect castorbean allergens.*

*Studies for allergens in castorbean meal lead to a risk-free, highly specific . . .*



## TEST FOR HUMAN ALLERGIES

■ A risk-free and highly specific test for human allergy, with far-reaching implications for future medical practice and research, has been developed by an ARS chemist at the Western utilization research laboratory, Albany, Calif.

This diagnostic test, developed in connection with research on allergy induced by the castorbean, won a USDA superior service award for its creator, L. L. Layton. Through the use of monkeys, Layton has kept the cost of allergy testing low and, more important, has eliminated the hazards associated with the use of human volunteers.

At least two risks are involved when the conventional scratch test is used in diagnosing a patient's allergy with a variety of suspected allergens. The patient may experience a serious anaphylactic reaction or shock to a test allergen. Or the patient may become

sensitized to substances that he otherwise would not have encountered.

Another diagnostic approach—the use of a human volunteer—also presents risks. In this case, a patient's blood serum is injected into the volunteer's skin and the sensitized skin area is later challenged with the suspected allergen. However, if the patient has serum hepatitis, it may be transferred to the volunteer. Again, there is the possibility of sensitizing the volunteer with substances he would not normally encounter.

These potential hazards are obviated by Layton's sensitive test procedures. The test animal used, the Philippine crab-eating monkey, was selected because of its light skin, small size, relative abundance, and low cost; however, it was found recently that any light-skinned monkey or ape can be used. Antibodies in the serum of sensitized humans were fixed in the

monkey's skin by injection. Twenty-four hours later the monkey was given an intravenous injection of blue dye and then challenged by either direct scratch test or intravenous injection of the suspected allergen. If the patient was allergic to the allergen, then the site sensitized by the serum turned blue.

Before Layton developed this monkey test for human allergy, scientists felt that it was not feasible to make these sensitive diagnoses except on the human body. In the 1920's, in tests considered definitive, scientists had failed to sensitize the skins of chimpanzees and lower order monkeys with a serum of allergic humans.

Layton also found that—

- The castorbean contains at least six specific antigenic compounds;
- Not all persons who are sensitive to castor meal are sensitive to the same antigenic components of the meal;

*Turn page*



## HUMAN ALLERGIES

(Continued)

- Pollen from the castor plant and other botanically related plants, such as poinsettias, can sensitize persons to castor meal;

- Allergy symptoms sometimes attributed to castor meal are often caused by the patient's sensitivity to contaminants unavoidably present in the meal, such as insect parts, molds, and other microscopic matter;

- The "allergy serum transfer" tests in monkeys are well correlated with human skin tests.

Through his test method, Layton has also successfully demonstrated human allergic reactions to ragweed, animal dander, penicillin, foods, and insects.☆

L. L. Layton's award-winning allergy test is a small but highly important part of USDA's broad program of establishing a self-sufficient U.S. castorbean industry.

His specific goal in this effort is to make possible the use of the castorbean's high-protein meal in livestock feed. This use hinges on removing the meal's allergenic properties, which pose a serious hazard to persons who handle it.

About 85 percent of the castorbeans now used in the U.S.—mainly for oil—are imported. But good yields of the beans can be obtained on land now growing cotton and feed grains. Since the castorbean is about half oil and half

meal, increased domestic use would be doubly advantageous.

In earlier allergy work, pioneering scientists of the Eastern utilization research laboratory demonstrated a method of inactivating the allergen by heating castorbean meal together with lime (AGR. RES., November 1961, p. 7).

In other research, ARS scientists have developed high-yielding varieties that are adapted to mechanization and that resist drought and disease (AGR. RES., March 1957, p. 12; August 1954, p. 11). Harvesters have been designed to handle these improved varieties (AGR. RES., July 1961, p. 14; March 1957, p. 12; July 1954, p. 4).

*Working with sugarbeets, utilization scientists develop a test that is useful in . . .*

## Diagnosing Galactosemia in Infants

■ A simple, sensitive test for the sugar galactose—worked out by two ARS chemists—is helping to diagnose a rare but severe metabolic disease in man.

This disease, called galactosemia, occurs in certain children born without the ability to metabolize galactose, a sugar constituent of many plant and animal products. The galactose in the lactose of milk accumulates in the blood of babies who inherit this disability and causes jaundice, enlarged liver, cataracts, and mental deficiency.

Galactosemia can be prevented by removing milk and other foods containing galactose from the susceptible baby's diet within a few days after birth. This means that early detection of the disease is vitally important. But present laboratory tests for galactosemia—and for detecting gen-

etic carriers—are too complicated and expensive for routine clinical use.

The ARS galactose test provides an answer to this medical problem. Informal reports from several hospitals and research institutions indicate that the test can be successfully adapted for use in detecting unmetabolized galactose in blood and urine.

The test was developed by E. S. Rorem (recently deceased) and J. C. Lewis at the Western utilization research laboratory, Albany, Calif. The chemists were studying galactose and galactose-containing constituents of sugarbeets that hamper sugar processing by interfering with sucrose crystallization.

Their simple and sensitive test is made with strips of paper prepared and treated with a preparation of galactose oxidase (enzyme) grown from

cultures of the fungus *Polyporus circinatus* Fr. The finished test paper has a light-tan color, which turns deep blue-green when dipped into a solution that contains galactose. Solutions containing as little as 0.01 percent galactose can be detected in less than 10 minutes.

The Albany laboratory has received numerous requests for both the test paper and the galactose oxidase enzyme preparation. Promising results with the Rorem-Lewis test in galactosemia-detection studies have been informally reported by Children's Hospital in Los Angeles, Harvard University Medical School, Iowa Methodist Hospital, and the South African Institute for Medical Research in Johannesburg. The South African Institute is also using the test to detect genetic carriers of the disease.☆

Researchers compare  
ways of overcoming . . .

# SLOW WATER INTAKE

. . . by dense, compact soils



*Deep disk plowing, 24 inches deep, increased water intake of Pullman soils by 90 percent.*

■ To those who farm about 12 million acres on the Southern Great Plains, the slow rate of water entry into Pullman and associated soils is a major obstacle to efficient crop production. But ARS research indicates it's an obstacle that can be overcome best by deep tillage with a disk plow.

At Bushland, Tex., the water-intake rate was 90 percent greater on plots that had been disk plowed 24 inches

*Vertical mulching in 24-inch-deep slots, spaced 80 inches apart, increased water intake of the compact Pullman soils by 50 percent.*



deep than on plots that had not been deep tilled. The experiments, which also included vertical mulching and chiseling to increase water intake, were in cooperation with the Texas Agricultural Experiment Station.

The top few inches of these soils consist of moderately permeable clay loam, underlain by a 16- to 20-inch clay layer that is dense, compact, and very slowly permeable. Water enters these soils at 0.5 to 1.0 inch per hour immediately after irrigation or rainfall, but intake declines to less than 0.1 inch per hour after 4 hours and to 0.05 inch per hour within 10 hours.

## Slow intake hampers terracing

Under dryfarming conditions, the slow water-intake rate of Pullman soils may partially nullify effectiveness of level bench terraces in saving runoff needed for crop production. Farmers sometimes must drain impounded water from the terraces to save crops from drowning or to permit farming operations. Also, farmers irrigating these soils have difficulty wetting the soil to the necessary depth within a reasonable time.

In experiments by ARS agricultural engineer V. L. Hauser and soil scientist H. M. Taylor, the water-intake rate remained undiminished 3

years after the deep disk plowing, indicating a permanent change in soil properties. The scientists say the improvement resulted from mixing the more permeable surface soil with the less permeable subsurface layers.

## Mulching raised intake 50 percent

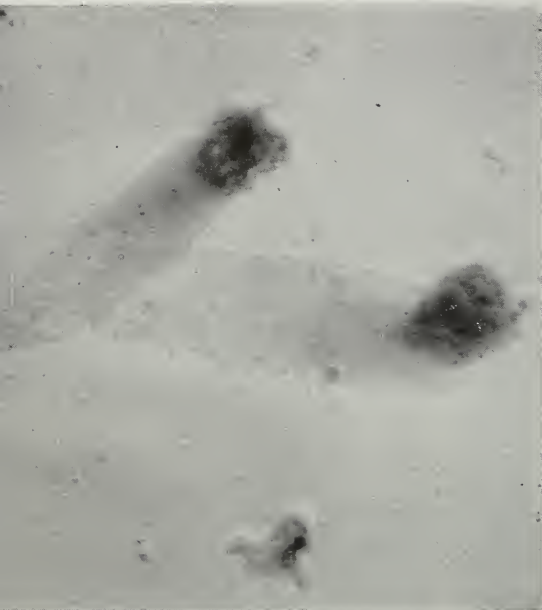
In a second approach—that of vertical mulching—Hauser and Taylor increased water intake 50 percent. In this operation, they opened V-shaped trenches or slots spaced 80 inches apart, and filled the openings with chopped sorghum forage. The trenches were 24 inches deep, 9 inches wide at the top, and 4 inches wide at the bottom.

The vertical mulching treatment remained effective after 3 years, and the residue in the slots still had not decomposed appreciably.

A third treatment, chiseling 24 inches deep in rows 80 inches apart, was ineffective after one irrigation.

The scientists say deep-disk plowing probably will not reduce crop yields—may even improve yields in some situations—if moisture and soil fertility levels are adequate. None of the treatments significantly affected yield of sorghum grown on the well-fertilized, adequately irrigated plots.☆





When the anaplasma organism is enlarged 17,500 times (left), an unusual tail-like projection is seen. The parasite (below) destroys the red blood cells of cattle infected with the disease.



Learning more about . . .

## ANAPLASMOSIS, how it spreads

■ The role of ticks and biting insects in spreading anaplasmosis, a costly cattle disease, is better known as a result of recent findings by ARS veterinarians and entomologists.

Anaplasmosis costs the U.S. cattle industry an estimated \$50 million each year. This infectious disease is characterized by anemia caused by a protozoa-like parasite, *Anaplasma marginale*, which destroys an animal's red blood cells. The disease does not affect man.

In recent studies at Beltsville, Md., the anaplasma organism survived at least 6 months in male Rocky Mountain wood ticks, *Dermacentor (andersoni) venustus*, that were unmated

and in hibernation. (Male ticks die after mating.)

This may explain, in part, how the disease organism overwinters in nature. It also suggests that male Rocky Mountain ticks may be especially important in spreading this disease in the Western United States, where the tick abounds. In many tick-borne diseases, the female tick perpetuates the disease through its infected progeny.

The ARS scientists also succeeded in finding the organism in tick intestine and in the excreta of infected ticks. They are now using the electron microscope to learn more about a peculiar projection sometimes seen

on the anaplasma organism and to study the organism's survival and development in ticks.

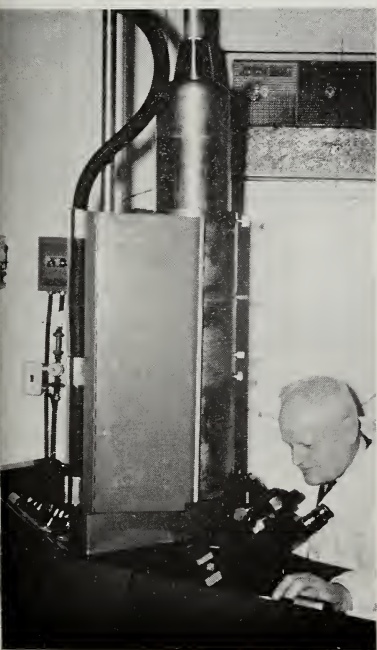
The parasite is being studied in the tick by the use of the fluorescent antibody technique. Antibodies—the blood-serum substances created by an animal to combat foreign materials, in this case the parasite—are combined with a fluorescent dye. This antibody-dye combination is added to a preparation made from the particular part of the tick being studied. If the parasite is in this part of the tick, the antibody-dye will stain the organism. The parasite can then be observed with a microscope equipped with an ultraviolet light source.



Once the scientists have located the parasite in a particular part of the tick, they use an electron microscope to study in detail the development and form of the parasite.

Anaplasmosis can be transmitted biologically or mechanically by many species of ticks and biting insects. In biological transmission, the parasite exists through various stages of the life cycle of infected ticks and can be passed on to host animals months after the carrier ticks have picked up the blood parasite. In mechanical transmission, the parasites are carried from diseased to healthy animals by flies, mosquitoes, and similar insects that move rapidly and feed on one animal after another. Anaplasmosis can also be transmitted mechanically through the use of unsanitary bleeding needles, dehorers, and other instruments.☆

*ARS veterinarian D. W. Gates focuses an electron microscope on a smear of tick feces to locate the organism of anaplasmosis.*



*Recent discoveries point to possible interrelated immunities between a boy, his dog, and his calf.*



## NATURAL CROSS-IMMUNITY

*Relationship between human, canine, and cattle diseases prompts study of immunity*

■ Scientists have learned that measles in humans, distemper in dogs, and rinderpest in cattle are caused by related viruses. What impact this knowledge will have on research is being explored in a joint study by scientists at the Plum Island Animal Disease Laboratory, Greenport, N.Y., and physicians at children's hospitals in Boston and Buffalo.

The work at Plum Island is directed by veterinarian P. D. DeLay and chemist S. S. Stone. The work at the Children's Hospital in Boston is conducted by J. F. Enders and S. L. Katz and at the Children's Hospital in Buffalo by D. T. Karzon.

The ARS research was initiated following reports of natural cross-immunity involving the three viruses. Dogs at an animal dis-

ease laboratory in Kenya, Africa, seemed to be immune to distemper, even though they had not been vaccinated against the disease but were exposed to rinderpest-infected goats.

Reports from various parts of the United States indicated that children having recovered from measles had acquired antibodies against distemper.

Studies of blood serums and resistance of animals inoculated with measles, rinderpest, and canine distemper viruses at the Plum Island laboratory added further data to indicate that the viruses share certain characteristics.

For example, puppies inoculated with either measles or rinderpest virus developed antibodies against that disease and were protected against distemper virus.☆

*A common weed—chenopodium—has gone to work for science as. . .*

## A TINY TEST PLANT



*A chenopodium plant, 1 week after sowing (left), has already emerged. After only 2 weeks (right), the plant has developed a flower—stimulated by light treatment; the plant, at this stage, is less than half an inch tall.*

■ A weed that can be made to grow from planting to maturity in less than 1 month—and, when mature, be no bigger than a thumbnail—looks promising as a valuable test plant for researchers.

This tiny plant (*Chenopodium rubrum*), a Canadian relative of the common weed lambsquarter, has replaced cocklebur, a popular test plant, in some ARS physiological studies of plant reactions to light.

Some 160 to 200 chenopodium plants can be grown in a 5- by 10-inch flat and take up less space than 5 or 6 cocklebur plants. Also, because of their small size, individual chenopodium plants can be exposed to much narrower spectral bands of light than

cocklebur plants. Response to light treatment is about the same for both plants.

Studies of chenopodium as a test plant have been made by M. J. Kasperbauer, a plant physiologist at the Pioneering Research Laboratory for Plant Physiology, Beltsville, Md.

### Helps trace responses to light

Kasperbauer says that chenopodium has helped researchers learn why different kinds of light sometimes cause similar responses in plants.

Scientists in the plant physiology laboratory have also used the plant to help demonstrate some of their basic light-reaction findings. For example, it's much easier to show, rather than explain, why plants similar to chenopodium prefer short days; they bloom only when stimulated by comparatively long night-time periods.

Kasperbauer says chenopodium can be used to demonstrate short-day effects in a simple, 3- to 4-week experiment:

- Sow a few of the tiny bead-like



seeds in two petri dishes containing soil or an agar-nutrient gel. After 2 or 3 days, the seeds will sprout.

Leave one dish exposed to ordinary light for about 18 hours each day (on a classroom desk, for example). Put the other dish in a drawer in darkness. then expose it to light only 7 or 8 hours of each day for 5 or 6 days. After that, put the dish on the desk with the other one.

About a week later, a pinhead-sized cluster of yellow flowers will begin appearing on each plant given the short-day treatments. Each flower will produce 1 or 2 seeds within a week.

Plants left exposed to long days and short nights won't flower. If transplanted and grown another month or two, they reach a height of several feet without flowering unless they are given several short days and long nights.☆

#### RESEARCH ASSOCIATESHIPS—

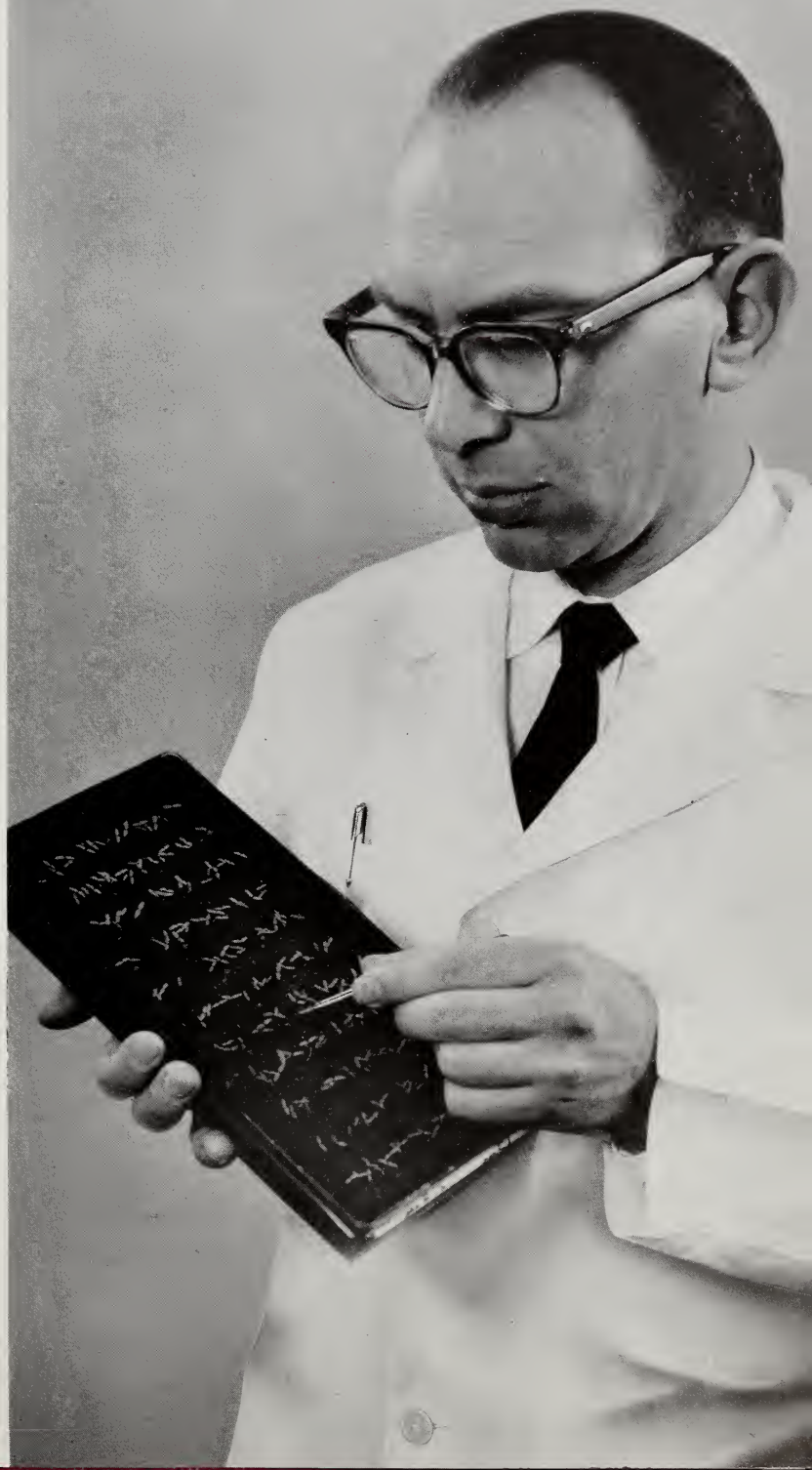
*Kasperbauer's work on chenopodium is an outcome of the ARS postdoctoral resident research program, which was initiated in 1961 to give promising young scientists advanced training under highly qualified veteran scientists.*

*Kasperbauer (right) joined the ARS Pioneering Research Laboratory for Plant Physiology, Beltsville, Md., as a research associate in 1962. He formerly was on the teaching staff of Iowa State University.*

*Trainees in the program have the equivalent of a Ph.D. or Sc.D. degree and have demonstrated superior ability for creative research.*

*Opportunities for research and training are made available in entomology, biochemistry, genetics, microbiology, mineral nutrition of plants, physical chemistry, microbiological chemistry, plant physiology, and plant virology.*

*Candidates for this program apply for participation through the National Academy of Sciences-National Research Council.*





# PORTABLE COOKERY



## *Home economists compare cooking with portable appliances and electric ranges*

■ Foods can be cooked as well in portable electric appliances as they can in utensils on an electric range, USDA household equipment researchers found in a comparison of these two methods of cooking.

One or more automatic utensils can supplement the range when additional cooking facilities are needed or when thermostatically controlled heat is desired. In fact, say the researchers, a set of four portable appliances may well serve as a substitute for a range—if adequate wiring is provided.

Lenore Thyne and Faith Churchill of the ARS Housing and Equipment Laboratory, Beltsville, Md., tested the individual cooking performance of two each of the following automatic appliances: 3-quart saucepans, 5-quart saucepots, fry pans, roaster-ovens, and rotisserie-ovens. Pots and pans of comparable sizes were used in

cooking foods with electric ranges. One set of cookware was made of stainless steel, the other of aluminum.

Thyne and Churchill established cooking time and electric energy costs—and made palatability evaluations—for individual foods and for foods combined into meals. Results of the tests showed that cooking time, temperature, or procedure suggested by the appliance and range manufacturer frequently needed minor adjustment.

Here are some of the results of the cookery studies:

- Three-quart automatic saucepans required less electric energy than the range and nonautomatic pan—an average of 1.06 kilowatt-hours compared with 1.24 for cooking five different foods. Foods cooked almost as quickly in the automatic pans as on the range. One exception was

*Time, temperature, and electric energy costs were recorded while food was being cooked with portable appliances and with ranges.*

french-fried potatoes, which required 17.2 minutes longer in the automatic utensil than on the range.

- Five-quart range pots used slightly more electric energy and took slightly less time to cook food than the automatic utensils.

- Foods cooked in the automatic fry pans were on a par with those cooked on the thermostatically controlled unit of the range. All fry pans used in this study showed uneven heat distribution, a characteristic that was most noticeable with griddlecakes. Darker browning occurred on portions of the griddlecakes immediately over the heating element in the automatic fry pans and in the center of the range fry pans. Heat distribution became more even in all fry pans as cooking progressed.

Roaster-ovens and rotisserie-ovens were compared with range ovens for their ability to maintain low and high temperatures—and for evenness of heat distribution.

*Foods were cooked by the range in utensils comparable in size to the portable appliances.*



- Although the portable ovens baked good products, the range ovens browned foods more evenly on both top and bottom. Better browning in range ovens resulted from a larger capacity for air circulation and from a better balanced heat input provided by lower and upper heating elements.

- Portable ovens used less total electricity but took more time than range ovens. Preheating the lower wattage portable ovens took 20 percent longer for the roaster and 9 percent longer for the rotisserie-ovens, which accounts for the main difference in cooking time. Actual baking time was just 2 or 3 minutes longer—except for frozen apple pie, which required 9 minutes more in the portable ovens than in the range ovens.

For broiling meat patties and toasting bread, portable ovens worked as well as the range ovens. However, the portable oven broilers required 39 percent more time for broiling meat patties and 55 percent more time for making toast. Uneven heat distribution was apparent in both portable and range broilers.

In cooking two typical dinner meals, a set of the automatic appliances used less electricity than an electric range. The researchers compared the cost of cooking these meals once a day for a year. At 2.5 cents per kilowatt-hour, the cost of cooking the first meal was \$17.70 with the portable appliances and \$25.82 with the range—a difference of \$8.12. For the other meal, the cost of cooking was \$22.62 with the combination of appliances and \$28.38 with the range—a \$5.76 difference.

The researchers found that cleaning automatic utensils required more time than was needed for cleaning nonautomatic utensils; when time required to clean the cooking counter and the range top was included, however, total cleanup time was the same.★

*A Cabin for . . .*

## Your Time-Off Spot



■ Farmers who are developing recreational areas or vacationers who are planning to build a retreat at the beach, lake, or mountains may find use for a new USDA cabin plan.

Developed by ARS architects and housing specialists, this plan (No. 5928) shows construction details for a basic 24- by 24-foot frame shell that provides a living and kitchen area, a bedroom, a bath, and lots of storage space.

The cabin can be expanded later to include a screened porch, a bunk room, or two additional bedrooms.

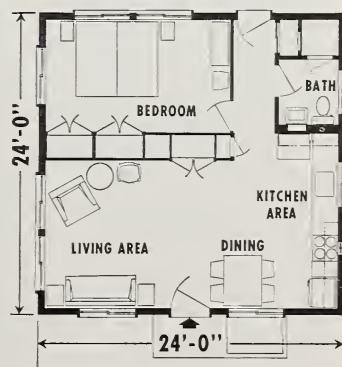
The exterior shell of the cabin can be built and the plumbing roughed in at a reasonable initial cost. Interior finish and a storage wall can be installed later. The storage wall, which is movable, divides the living room and bedroom.

The cabin is designed for construction on a concrete slab. If it is built on steeply sloping terrain, however, the architects say it is more economical to build a wooden

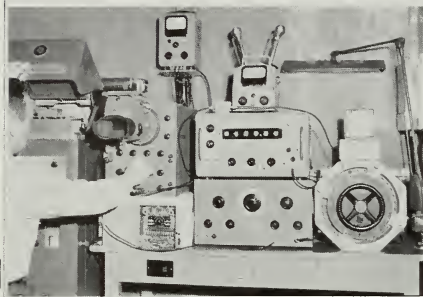
floor on piers of concrete, masonry, or creosote-treated poles.

Hot-air, hot-water, or electrical heat can be used in the cabin. If future expansions are planned, the heating plant should have sufficient capacity to provide heat for the anticipated additional floor space.

Working drawings of plan No. 5928, "Cabin," are available through farm building specialists or extension agricultural engineers at most State agricultural colleges. There is usually a small charge.★







*S. O. Nelson inserts a sample of alfalfa seed for radio-frequency treatment to increase germination of hard seed.*

■ Equipment similar to radio and television transmitters is being used to increase the germination rate of alfalfa seed in ARS and Nebraska tests at Lincoln.

By exposing small samples of alfalfa seed to an electric field, oscillating at a frequency of 39 megacycles, scientists increased germination in one lot of seed from less than 50 percent to more than 90 percent.

#### **Treatment "softens" hard seed**

The treatment increases germination by reducing the percentage of hard seed. Hard seed lie in the ground several weeks or months before absorbing water and germinating. Some never germinate.

Farmers object to seed supplies containing a high percentage of hard seed, and seedsmen have difficulty selling them.

In research at the Nebraska Agricultural Experiment Station, ARS agricultural engineer S. O. Nelson and agronomist W. R. Kehr found radio-frequency (r-f) treatment effective on all lots of alfalfa seed tested. Although all the seed lots did not respond alike, each showed a significant increase in germination.

#### **Driest seed respond best**

Seed dried to 2 percent moisture responded better to the r-f treatment

# TRANSMITTING Germination

*Alfalfa seed viability is nearly doubled by radio-frequency treatment*

than seed treated at normal moisture levels of 6 to 8 percent.

Equipment used in this research is designed to direct the r-f energy into the seed rather than to radiate it into space as in radio and television transmission.

Nelson and Kehr think that r-f treatment increases the germination of hard seed because it causes a sharp rise in the internal temperature of the seed. This temperature change, they believe, may alter the seed structure in such a way that the seed can take up moisture and germinate. Treated seed absorb water more rapidly than untreated seed.

Commercial seedsmen now scarify

(scratch) the surface of seed mechanically to speed water absorption and thus speed germination. Scarified seed should be planted soon after treatment, however, because the seed deteriorates in storage. In contrast, seed lots that received the r-f treatment have remained viable since research was started 4 years ago.

Before the r-f seed treatment can be recommended, field tests must be made, to learn whether treated seed grow as well outdoors as in a greenhouse or in a germinator. Although Nelson cannot yet say how much the treatment would cost growers, he estimates that it would cost only a few cents a bushel if used on a large scale. ☆

*Less than 50 percent of untreated seed (left) germinated, compared with over 90 percent of the treated seed (right).*





# REPEAT BREEDERS

*Scientists use hormones in studying a stubborn problem in dairy herds*

■ Results of a hormone-injection study demonstrate the difficulty in determining why some cows must be bred many times before settling.

This study was done by ARS to learn whether injecting repeat-breeder cows with hormones during the early stages of pregnancy, and removing their ovaries, might keep developing embryos alive. Early embryo fatality is the main reason why repeat-breeder cows return to heat instead of calving.

## Hormones and survival rate

Although the results indicate that hormones had little effect on the number of surviving embryos in repeat-breeder cows, the researchers found that embryos remained alive in hormone-injected cows of normal fertility—even though their ovaries were removed 5 days after breeding.

A team of scientists headed by animal physiologist H. W. Hawk conducted the study at Beltsville, Md. Two groups of dairy cows were tested. One group was composed of 15 cows of normal fertility (such cows usually calve after being bred once or twice). The other group was composed of 20 cows that appeared normal except for repeat-breeding tendencies. Most of these cows had calved earlier, but each animal had been bred several times since calving without becoming pregnant. Both groups of cows were free of venereal disease and anatomical defects.

At the beginning of the study, the

repeater-breeder group was bred artificially with semen of bulls known to be fertile. Only three cows became pregnant. The other 17 cows returned to heat and were bred again. At this time, the 15 cows of normal fertility were also bred.

Beginning 4 days after breeding, hormones were injected daily into the normal cows and the 17 repeat breeders, which had been mated a second time. Some of the cows received progesterone and estrogen; others received only progesterone.

A day after injections began, the animals' ovaries were surgically removed so that any hormone secretions by the ovary during pregnancy would not cloud the results obtained with the hormone injections. This is believed to be the first time ovariectomy has been tried in cattle so early in pregnancy.

## Embryos survived in normal cows

Cows were slaughtered at various intervals during the study and examined for evidence of pregnancy. Each cow in both groups received hormone injections until it was slaughtered—in some cases, 60 days after breeding.

Examination showed that 11 of the 15 normal cows were pregnant. Of the remaining four cows, two had been carrying dead embryos which had lived about 7 weeks, and two showed no evidence of being pregnant.

In contrast, only 3 of the 17 repeater-breeder cows were pregnant when

examined. In five others the embryos had died within 5 weeks after conception. There was no evidence of pregnancy in the remaining nine cows.

What kept most of the repeater-breeder cows from becoming or staying pregnant? The scientists aren't sure.

Any imbalance in the kinds of hormones injected should be discounted—there was no difference in results between cows getting progesterone alone or in combination with estrogen.

## Ovaries may account for defects

Ovaries of the repeat breeders may have exerted an adverse effect on fertility during the 5 days between breeding and the time the ovaries were removed. For instance, they may have been producing a high proportion of defective eggs. Or they may have caused an imbalanced secretion of hormones that affected embryos less than 4 or 5 days old.

Another possibility: The repeater-breeder cows may have produced antibodies against sperm or embryonic tissue that prevented or terminated pregnancy (AGR. RES., September 1962, p. 13).



These and other possible explanations are being investigated in various ARS studies, which include the effects of venereal disease on fertility (AGR. RES., November 1962, p. 11), and the effect of nutrition on fertility (AGR. RES., December 1961, p. 7). ☆

TOP—The growth regulator phosfon induced berry production and retarded growth of the holly variety at right; the untreated plant at left made normal growth without bearing.

BOTTOM—Phosfon also stimulated berry production in the hybrid holly at right but did not retard growth as it did in the nonhybrid variety. The hybrid at left was not treated.



## FORCED FRUITING

*Chemical growth regulators hasten flowering and berry production in holly plants*

■ Growth-retarding chemicals have stimulated flowering and berry formation in two kinds of holly plants less than 2 years old. Holly plants usually take much longer to mature, although the length of time they need depends on the species.

The results with holly were obtained by ARS agronomist P. C. Marth at the Agricultural Research Center, Beltsville, Md., in research that is part of long-range efforts to learn more about growth regulators. Holly was used because this woody perennial is similar in some respects to fruit-bearing trees. It produces berries, for example, the same way trees produce fruit or nuts.

### Study has broad implications

The outcome of the study could mean that florists and nurserymen may soon be able to produce a more dependable supply of holly plants that are in the bearing stage. It may also benefit fruitgrowers and help shorten studies of nut production, which are prolonged by the time required for

nut trees to bear.

Marth tried three growth retardants—CCC, CO 11, and phosfon—on holly cuttings grown in pots. The two kinds of holly used were *Ilex cornuta* and the hybrid *I. aquifolium* x *I. cornuta*. All the plants were grown in a greenhouse. (Phosfon has been registered by USDA for use as a growth regulator on chrysanthemums and Easter lilies. The companies that developed CCC and CO 11 have not yet applied for registration by the Department.)

The holly cuttings were rooted for the experiment in January 1961, and some of the plants were treated with retardants the following July. By October 1962, most of the treated plants had flowered and produced berries, but none of the untreated plants had even flowered.

Although the treatments stimulated flowering and berry formation in both kinds of holly, they retarded stem and foliage development only in the holly variety—not in the hybrid. This suggests, Marth says, that retardation of

growth may not be the only mechanism by which plants can be made to start flowering.

Marth is studying the mechanisms that govern plant development as a staff member of the new Pioneering Research Laboratory for Plant Hormones and Regulators at Beltsville, Md. Further studies based on the results with holly are being planned.

### Retardants are versatile

Previous ARS research on growth regulators has shown that retardants can be used to delay bean-plant blossoming, lengthen the life of some plants, and produce compact chrysanthemums (AGR. RES., April 1961, p. 10). Growth-retarding chemicals can also dwarf soybean plants and make them salt tolerant (AGR. RES., October 1961, p. 5), trigger bud development in azaleas (AGR. RES., November 1961, p. 15), shorten the stems of Easter lilies (AGR. RES., March 1962, p. 13), and reduce stemminess in poinsettias (AGR. RES., December 1962, p. 13). ☆



## Magnesium in human nutrition

Recent evidence of the importance of magnesium in human metabolism has prompted ARS nutrition specialists to review information on the amount of magnesium in human tissues, the role and metabolism of magnesium in the body, and human requirements for this mineral.

Their review indicates that the chief biological role of magnesium is as an activator of many important enzymes. It activates the enzymes, for example, that are involved in muscular activity, nerve conduction, glucose utilization, and synthesis of proteins, fat, carbohydrates, and nucleic acid.

Magnesium metabolism is closely related to that of potassium, calcium, and phosphorus, but its relation to endocrine functions has not been established.

Magnesium requirements seem to be related to protein intake; as protein consumption increases, the need for magnesium increases also. Using this magnesium-protein relationship as a guide, the researchers developed the following estimates of daily requirements for magnesium (based on normal consumption of protein in the United States): Children up to 10 years, 150 milligrams; pre-adolescents, 200 mg.; adolescents, 250 to 300 mg.; young women, 300 mg.; and young men, 400 mg.

An adequate magnesium intake is not likely to be a problem for normal persons on an adequate diet, the nutrition specialists say, but maintaining magnesium equilibrium may be a problem when the amounts of several related nutrients are limited.

The review, published as "Magnesium in Human Nutrition" (HERR

No. 19), contains an extensive bibliography for research workers and suggests further areas of study. Single copies may be obtained free from the Office of Information, U.S. Department of Agriculture, Washington 25, D.C.

## Pasture water intake rate

The extent to which stockmen can conserve needed moisture on Northern Great Plains pastures—and thus increase forage production—has been demonstrated in ARS research at Mandan, N. Dak.

A moderately used pasture at USDA's Northern Great Plains Field Station absorbed the equivalent of 2 inches of rain without runoff in a 30-minute artificial rainstorm. Flash-flood storms of this intensity occur once in 2 years in this area. The pasture had been grazed for 46 summers at the rate of 2 acres per steer per month (0.50 animal-unit months).

In experiments by ARS soil scien-



tist Frank Rauzi, a nearby heavily used pasture could absorb only a little more than half of a simulated 2-inch rainstorm in 30 minutes. The rest was lost as runoff. Summer grazing of this pasture for 44 years had been at an average rate of 0.8 acre per steer per month (1.25 animal-unit months).

Rauzi applied water at storm intensities of 3.0 to 4.5 inches per hour, using a mobile rainmaking machine. The soil in the area is Eakin silt loam, and the dominant grasses are blue grama, western wheatgrass, needle-

and-thread, and threadleaf sedge.

Forage production of Great Plains pastures is limited by the amount of water entering the soil, Rauzi points out. And water intake is greatly influenced by the amount of new grass, new broadleaf plant growth, and the mulch of dried forage built up in previous seasons.

A stockman who carefully controls the number of livestock allowed to graze can therefore maintain a high rate of moisture penetration, Rauzi says, and obtain maximum forage yields.

## Bacterium kills forest insects

Commercial preparations of a bacterium, *Bacillus thuringiensis* Berliner, have been successfully used against five forest insects in laboratory tests performed by the U.S. Forest Service. The bacterium was used in the laboratory against the spruce budworm (green form), black-headed budworm, western hemlock looper, western oak looper, and pandora moth.

In a small-scale field test, hemlock looper larvae suffered complete mortality over a 2-week period, indicating that the bacterium may have practical control value against this insect.

These tests are part of a study underway at the Forestry Sciences Laboratory in Corvallis, Oreg., to determine the nature of diseases affect-



ing insects of western forest trees and browse plants and to develop means of using the diseases against the insects.



## AGRISEARCH NOTES

### A green-boll separator

An experimental cotton-boll separator developed by ARS agricultural engineers at Lubbock, Tex., may lead to earlier harvesting and a better crop of High Plains cotton.

Cotton harvested before frost has higher lint quality than cotton harvested after frost because it is subjected to less weathering. When the crop is harvested before frost, however, it contains many immature bolls that must be separated from the mature bolls before the cotton is ginned. Although commercial strippers are equipped with separators, they can't handle the increased green bolls in the earlier harvested cotton.

The experimental separator, which is designed as an attachment for a stripper harvester, removed nearly 10 times more immature bolls than a conventional separator in tests by I. W. Kirk, E. B. Hudspeth, Jr., and E. R. Holekamp, at the Texas Agricultural Experiment Station.

Mature cotton separated by the test unit contained less than 3 percent green bolls, compared with nearly 30

percent green bolls in mature cotton separated by a conventional unit. The cotton was stripper harvested from two 3-acre plots.

Cotton grown in the High Plains of Texas and Oklahoma is harvested with a machine that strips all the bolls from the plant at the same time. The bolls go into the separator, where the light and fluffy mature cotton is blown through a conveyor into a wagon or basket. The heavier immature bolls drop into a box and are later piled in the field to dry.

The ARS engineers designed the experimental boll separator so that it will load the harvested mature cotton either into a wagon hitched behind the stripper or into a basket mounted on top of the tractor.

### Spacing of Pima cotton

Proper spacing of Pima cotton plants of the S-1 and S-2 varieties affects yield, early maturity, and type of plant growth, ARS scientists have shown in tests conducted cooperatively with the Arizona Agricultural Experiment Station.

Spacing the plants 3 to 6 inches apart seems desirable under most conditions, agronomist C. V. Feaster and geneticist E. L. Turcotte of ARS and agronomist R. E. Briggs of the Arizona station conclude, as a result of growing trials at Tempe and Safford.

The spacing studies are part of research being conducted to determine the best combination of practices for growing the comparatively new S-1 and S-2 varieties. Pima cotton is grown on only a small percentage of the total cotton acreage in the United States, but production is increasing at a rapid rate. Most Pima cotton is produced in Arizona, New Mexico, and Texas.

In growing trials conducted during 1960, 1961, and 1962, the research group learned that within-row spacing of about 6 inches is satisfactory for most conditions in Pima production areas. However, where good root systems were established, 3-inch spacings proved equally satisfactory. Thinning was needed under most conditions if plants were placed any closer than 3 inches apart. In some instances, the scientists found that plants yielded well when spaced up to 12 inches apart, but yield generally dropped off when the space between plants exceeded 12 inches.

Plants spaced less than 3 inches apart developed small, spindly stalks. The fruiting branches are short, and the bolls develop too close to the stalk and too high on the plant. Spacing plants too far apart results in excessive branching, long fruiting branches, and late boll maturity.



*Engineers have designed an attachment for the cotton stripper that greatly increases the efficiency of separating green bolls from mature cotton.*